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Environmental Sustainability: A Pathway to Sustainable Development in Nigeria

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Abstract

Environmental sustainability is a critical driver for achieving sustainable development in Nigeria–a country endowed with abundant natural resources yet burdened by escalating environmental challenges. This paper first explores the concept of environmental sustainability within the Nigerian context, highlighting its correlations with sustainable development. It examines the threats that the nation's rich biodiversity faces, including deforestation, pollution, and the impacts of climate change. It further appraises the pivotal role of environmental sustainability, emphasizing how ecological protection supports economic growth, public health, and social stability. The discussion equally identifies significant challenges impeding Nigeria's efforts, such as weak policy enforcement, industrial pollution, urbanization pressures, and low public environmental awareness. In response to these challenges, the paper proposes an Innovation Model for Sustainable Development as a strategic pathway to foster resilience against environmental degradation, drive economic growth, and ensure social equity. By promoting green technologies, empowering communities, enhancing environmental governance, and fostering cross-sectoral partnerships, the model seeks to ensure inclusive and environmentally responsible development that promotes sustainable practices across all sectors. Strengthening environmental sustainability efforts through innovative approaches is therefore essential for Nigeria's pursuit of long-term economic growth, social equity, and environmental stewardship.

Keywords: Environmental sustainability, Sustainable development, Innovation model, Climate change, Environmental governance.

1 | Introduction

Nigeria, Africa's most populous nation and one of its largest economies, is endowed with natural resource wealth, boasting forests, fertile lands, and oil and gas reserves. Still, the country faces severe environmental degradation as a result of resource exploitation, industrialization, urban sprawl, and unsustainable farming

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practices. Due to these challenges, the long-term growth and stability of the nation, as well as the well-being of its citizens, are put at risk, causing Nigeria to lag in these global metrics. In this regard, achieving sustainable development is closely tied to addressing the threats posed by Nigeria's unsustainable environmental policies. Environmental sustainability is determined by how an ecosystem is interacted with and preserved to avoid depleting resources, therefore protecting the systems for future generations. As it stands, Nigeria must implement ecological sustainability into its development policies and frameworks, for the environment does not wait for people. The consequences of ignoring the environment in national policies, as shown by the rising rate of desertification in the north, declining oil quality in the Niger Delta, southeast erosion, and urban center pollution, prove that economic growth achieved at the expense of ecology is a failure dressed in success. This paper highlights the concept of environmental sustainability within the Nigerian framework, assesses its importance in achieving sustainable development, discusses the key challenges hindering progress, and provides recommendations for promoting sustainability.

2 | Understanding Environmental Sustainability in the Nigerian Context

Understanding and advancing environmental sustainability is crucial if Nigeria is to achieve its development aspirations and make a meaningful contribution to global efforts toward a greener, more resilient future.

2.1 | Meaning and correlations of Environmental Sustainability and Sustainable Development

Environmental sustainability refers to the responsible interaction with the environment to prevent the depletion or degradation of natural resources, thereby maintaining long-term environmental quality [1]. Goodland puts it as "the improvement of human welfare by protecting the sources of raw materials used for human needs and ensuring that the sinks for human wastes are not exceeded, to prevent harm to humans" [2] while Leke and Leke, aptly defined it as "the conversion, management and rational use of natural resources to maintain the wholesomeness of each ecosystem, support all the life forms and guarantee that biodiversity is preserved and that environmental degradation is prevented" [3]. Summarily, environmental sustainability is the planning, implementation, and management of activities that ensure the preservation, protection, and responsible use of natural resources, so that ecosystem services and overall quality of life are sustained for present and future generations.

Sustainable development, as defined by the United Nations, seeks to meet the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development, as defined by the United Nations, is the process of meeting the needs of the present without compromising the ability of future generations to meet their own needs. It is built upon three interconnected pillars: economic growth, social inclusion, and environmental protection. Within this framework, environmental sustainability serves as a foundational pillar, revealing that ecological health is necessary for achieving long-term development outcomes. It adopts a holistic approach that balances environmental integrity, economic advancement, and social well-being. Hence, the United Nations' [4] Agenda for Sustainable Development declared that a healthy environment is a necessary driver of economic growth and social development.

Environmental sustainability involves maintaining the delicate balance between human development and the planet's ecological capacity. It ensures that economic progress does not come at the expense of environmental degradation or social exclusion. For Nigeria, achieving this balance requires intentional strategies to protect and restore ecosystems while expanding inclusive economic opportunities and promoting social justice.

The urgency of environmental sustainability in Nigeria is magnified by its ecological diversity, dependence on natural resources, and the increasing severity of environmental challenges. The country is endowed with a diverse range of ecosystems, including tropical rainforests, savannas, mangroves, and inland freshwater systems. These ecosystems provide critical services, including food production, carbon sequestration, water

purification, and climate regulation. These natural systems sustain key sectors of the Nigerian economy, including agriculture, fisheries, forestry, and renewable energy [5]. For instance, the mangrove forests of the Niger Delta, the largest in Africa, play a crucial role in supporting fisheries, agriculture, and biodiversity conservation. These mangroves not only contribute significantly to the country's Gross Domestic Product (GDP) but also provide livelihoods for millions of Nigerians, particularly in coastal and rural communities [6].

2.2 | Nigeria's Ecological Crisis

Despite their value, Nigeria's ecosystems are under severe pressure from deforestation, pollution, land degradation, and the impacts of climate change. Without decisive and sustainable interventions, the degradation of these natural systems could undermine economic resilience, threaten food and water security, and increase social vulnerability. For example, in the Niger Delta, oil spills and gas flaring have led to severe environmental degradation, impacting local livelihoods and biodiversity [7].

Similarly, large-scale deforestation in states such as Cross River and Ogun has accelerated the loss of forest cover, contributing to the rapid desertification in northern Nigeria. Nigeria's deforestation rate is reportedly among the highest globally, with an estimated annual loss of 3.7% of forest cover [8]. Unsustainable agricultural practices, illegal logging, urban sprawl, and infrastructure development continue to degrade the landscape. In urban areas, improper waste management, air pollution, and water contamination pose significant threats to public health and the environment. Without effective interventions, these environmental crises will continue to undermine Nigeria's development efforts.

Understanding environmental sustainability in Nigeria, therefore, demands recognizing the interconnectedness of natural resource management, economic policies, and social development and integrating economic development goals with ecological preservation. It implies adopting policies that encourage responsible natural resource management, pollution control, waste reduction, the use of renewable energy, and climate resilience. Sustainable practices, such as afforestation, the adoption of clean energy, and pollution control, must be prioritized to protect Nigeria's environment and support long-term national development. Again, international sustainability frameworks such as the United Nations Sustainable Development Goals (SDGs)—particularly SDG 13 (Climate action), SDG 14 (Life Below Water), and SDG 15 (Life on land)—provide guiding principles for Nigeria to align its environmental initiatives with global best practices [9]. Therefore, promoting environmental sustainability is not a luxury but a necessity for Nigeria's survival, prosperity, and legacy for future generations.

3 | The Role of Environmental Protection in Achieving Sustainable Development

The concept of sustainable development must incorporate the core patterns of economic growth, environmental stewardship, and social inclusion, supported by key performance principles. According to the United Nations Agenda 21 [10], these principles include: Preserving the quality of the environment, facilitating inclusive economic development, and addressing social, demographic, and cultural challenges. In this framework, environmental protection is not an optional consideration—it is indispensable, especially for resource-dependent economies like Nigeria. It forms the backbone of economic stability, public health, social equity, and national resilience in the face of climate-related shocks and developmental pressures.

As initially defined by the Brundtland Commission, sustainable development is "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" [1]. This definition positions environmental protection, economic progress, and the elimination of social disparities as interconnected and mutually reinforcing priorities. For Nigeria, environmental sustainability is crucial to maintaining the availability and quality of natural resources that support key sectors, including agriculture, energy, water, and public health. Sustainable environmental practices contribute to poverty reduction, job creation, and climate resilience —all of which are essential to national development.

To effectively achieve sustainable development in Nigeria, the following areas require strategic focus:

3.1 | Environmental Health and Economic Stability

The Nigerian economy is structurally dependent on resource-based sectors, which depend directly on the environment. These sectors include agriculture, oil and gas, mining, and fisheries. Agriculture alone engages approximately 35% of the working population and constitutes a significant portion of Nigeria's GDP [11]. Productive soils, clean water, and predictable weather all contribute to the sustainability of agricultural productivity. However, soil erosion, land degradation , and desertification, aggravated by unsustainable activities, represent serious threats to food security and livelihoods in rural areas [8].

Similarly, while the oil and gas industry remains Nigeria's economic mainstay, it is also a significant source of environmental degradation. Oil spills, gas flaring, and the discharge of toxic substances into water bodies have severely impacted the Niger Delta ecosystem, leading to the displacement of local communities and the destruction of livelihoods based on fishing and farming [7]. Without robust environmental safeguards, the economic benefits derived from these resource-dependent sectors are unsustainable. Long-term economic stability requires strategic environmental management to ensure that natural assets continue to support growth, employment, and national development.

3.2 | Environmental Protection and Public Health

A clean and healthy environment is essential for achieving optimal public health outcomes. In Nigeria, inadequate waste management, industrial emissions, and contaminated water sources contribute to a high incidence of environmentally-linked diseases. Waterborne illnesses, such as cholera, dysentery, and typhoid fever, remain widespread in both urban and rural areas due to inadequate access to safe drinking water [12].

In addition, air pollution — especially in densely populated urban centers like Lagos, Kano, and Port Harcourt — frequently exceeds internationally recognized safety thresholds. This exposes millions of Nigerians to respiratory diseases, including asthma, bronchitis, and other chronic conditions [13]. By prioritizing environmental protection through effective waste disposal systems, industrial emission regulations, and water purification infrastructure, Nigeria can dramatically reduce its public health burden. These actions not only improve population well-being but also lower healthcare costs, boost labor productivity, and enhance quality of life, thereby supporting broader sustainable development objectives.

3.3 | Social Equity and Environmental Justice

Environmental degradation disproportionately impacts vulnerable and marginalized populations, particularly indigenous communities, women, and rural farmers, who often lack adequate access to natural resources, institutional support, and participation in decision-making processes. These groups bear the brunt of environmental harm and are frequently excluded from remediation efforts. For instance, residents of the Niger Delta have endured decades of environmental injustice, marked by extensive oil pollution, ecosystem destruction, and inadequate compensation or restoration efforts from responsible parties [7]. This persistent inequity illustrates that environmental protection is not only an ecological or economic concern but also a critical social justice issue. Therefore, advancing environmental justice requires ensuring equitable access to clean air, safe drinking water, fertile land, and a healthy living environment for all Nigerians. It is a crucial step toward achieving inclusive development, poverty reduction, and social cohesion nationwide.

3.4 | Environmental Sustainability and National Resilience

In an era defined by climate change and growing global environmental risks, national resilience is intrinsically linked to effective environmental sustainability practices. Nigeria is already facing the tangible effects of climate change, including intensified droughts in the north, coastal erosion and sea level rise in the south, and increased flooding in urban centers [14]. These environmental shocks pose serious threats to infrastructure, food systems, public health, and livelihoods. To strengthen national resilience, Nigeria must invest in

sustainable environmental strategies, including reforestation, wetland restoration, climate-smart agriculture, and disaster risk reduction. These initiatives enhance adaptive capacity, safeguard critical ecosystems, and mitigate vulnerability to environmental hazards. Proactive investment in environmental protection ensures that Nigeria can not only withstand future shocks but also maintain economic stability, safeguard communities, and fulfill its sustainable development objectives amid global uncertainties.

4 | Challenges to Environmental Sustainability in Nigeria

Despite the increasing awareness of environmental sustainability's importance, Nigeria faces multifaceted and deeply entrenched challenges that hinder effective environmental protection. These challenges are rooted in economic dependence on natural resources, weak institutional frameworks, technological gaps, and limited public engagement. The following are key barriers undermining Nigeria's pursuit of environmental sustainability:

4.1 | Industrialization and Oil Exploration

Nigeria's path to industrialization, particularly through its oil and gas sector, has come at a significant environmental cost. The Niger Delta region, which accounts for over 90% of Nigeria's oil exports, is among the most ecologically fragile areas in the country. For decades, the region has suffered from rampant oil spills, gas flaring, and widespread land and water contamination, leading to the degradation of vital ecosystems and the displacement of local and indigenous communities [15]. Additionally, urban industrialization in cities such as Lagos and Port Harcourt has led to severe air and water pollution. Many industries discharge untreated effluents into rivers, lakes, and lagoons, while emissions from factories and vehicles significantly deteriorate urban air quality [16]. The absence of comprehensive environmental regulations, coupled with weak enforcement mechanisms, has allowed industrial growth to proceed largely unchecked, compromising environmental health, biodiversity, and the well-being of host communities.

4.2 | Weak Enforcement of Environmental Laws

While Nigeria has enacted several legal frameworks to advance environmental sustainability, notably the National Environmental Standards and Regulations Enforcement Agency (NESREA) Act of 2007, implementation remains inconsistent and largely ineffective [17]. Challenges include insufficient institutional capacity, inadequate funding, corruption, and political interference, all of which undermine regulatory enforcement. Critical tools such as Environmental Impact Assessments (EIAs), which are mandatory for major infrastructure and development projects, are frequently poorly conducted, ignored, or manipulated to favor vested interests. Moreover, penalties for environmental violations are either too weak to serve as deterrents or are rarely enforced, enabling polluters to operate with impunity. This systemic weakness continues to erode public trust and limits progress toward achieving meaningful environmental protection across Nigeria.

4.3 | Public Awareness and Education Gaps

Public awareness of environmental issues and the integration of sustainability education remain critically low across many regions in Nigeria. A significant portion of the population remains unaware of the long-term environmental consequences of daily practices, including indiscriminate waste disposal, bush burning, and illegal logging. In many rural communities, economic survival often takes precedence over environmental stewardship, leading to the continuation of unsustainable practices [18]. Moreover, environmental education is insufficiently embedded within Nigeria's formal educational curriculum, leaving future generations underprepared to address pressing environmental and climate challenges. This gap in public knowledge and environmental literacy limits the effectiveness of government policies and environmental programs, which often lack the grassroots support necessary for sustainable implementation and impact.

4.4 | Rapid Urbanization and Population Growth

Nigeria is experiencing one of the fastest urbanization rates globally, with over 50% of its population now residing in urban areas [16]. This rapid urban growth—frequently unplanned and under-regulated—places tremendous pressure on land use, infrastructure, energy supply, and waste management systems. The emergence of slums and informal settlements, often lacking basic sanitation, clean water, and efficient waste disposal, has intensified environmental degradation. Simultaneously, the demand for new housing, transportation systems, and industrial infrastructure contributes to the deforestation of peri-urban areas, the destruction of wetlands, and the loss of biodiversity. Compounding the problem is Nigeria's high population growth rate, estimated at 2.5% annually, which accelerates resource depletion, land scarcity, and environmental stress [19]. This dual challenge of rapid urbanization and demographic pressure requires coordinated planning and sustainable urban development strategies.

4.5 | Climate Change Impacts

Nigeria is highly vulnerable to the impacts of climate change, which poses significant environmental and socio-economic risks. The country is increasingly experiencing more frequent and severe droughts, desertification, flooding, and rising sea levels [20]. In the northern regions, desertification continues to displace communities and escalate resource-based conflicts, particularly between farmers and herders. In the southern coastal zones, including key economic hubs such as Lagos and Port Harcourt, coastal erosion and urban flooding pose a significant threat to infrastructure, livelihoods, and public safety. These climate-induced challenges intensify the strain on Nigeria's already fragile infrastructure, highlighting the need for robust climate adaptation and mitigation strategies. However, progress is impeded by limited financial resources, insufficient technical capacity, and inadequate institutional support, leaving the country vulnerable to escalating climate-related threats.

5 | Strategic Pathways Towards Promoting Sustainability and Development

Addressing Nigeria's environmental sustainability challenges requires a multi-dimensional, cross-sectoral approach. Effective progress hinges on coordinated efforts among government agencies, private sector stakeholders, civil society, local communities, and international partners. Strategic pathways that integrate environmental sustainability, economic development, and social equity are essential to ensure long-term national resilience and prosperity. They include:

5.1 | Strengthening Policies and Regulatory Frameworks

A fundamental step toward sustainability involves strengthening Nigeria's environmental regulatory frameworks. Although mechanisms such as the NESREA Act and the EIA Act are in place, their implementation remains weak due to inadequate enforcement, limited funding, and outdated provisions [21]. Environmental governance must be mainstreamed across all development sectors, including agriculture, housing, transportation, and energy, through the application of environmental audits and sustainability assessments. Strengthening penalties for non-compliance, increasing budgetary allocations, and promoting voluntary environmental certification schemes can enhance compliance. Furthermore, Nigeria should design and implement a National Green Growth Strategy, aligned with global models like those adopted in Rwanda and South Korea, to drive eco-inclusive economic transformation [22].

5.2 | Promoting Green Technologies and Renewable Energy

The adoption of green technologies and renewable energy solutions is vital to reducing Nigeria's dependence on fossil fuels and environmentally harmful practices. Transitioning to solar, wind, hydro, and biomass energy sources can significantly cut greenhouse gas emissions and improve access to clean energy, particularly in

rural and off-grid communities [23]. To scale up renewable energy, the government should introduce targeted incentives, such as tax holidays, feed-in tariffs, green bonds, and low-interest financing, for clean energy projects. Initiatives like the Solar Power Naija program under the Economic Sustainability Plan represent promising steps but require broader geographical and infrastructural expansion [24]. In the agriculture sector, promoting climate-smart agricultural practices—including drip irrigation, organic farming, agroforestry, and drought-resistant crops—can enhance productivity while conserving natural resources.

5.3 | Community Involvement and Environmental Education

Environmental sustainability efforts must be community-driven to succeed. This is because community participation is indispensable to sustainable environmental management. Local communities are both the primary beneficiaries and stewards of natural resources, and must be empowered through education, incentives, and inclusion in decision-making processes. Environmental education should be mainstreamed across Nigeria's educational system, from primary schools to tertiary institutions. Additionally, public awareness campaigns utilizing radio, television, digital platforms, and community forums can promote behavioral change regarding issues such as waste management, conservation farming, and energy use [18]. Moreover, leveraging traditional governance systems, faith-based institutions, and community-based organizations enhances the local ownership of sustainability programs. Integrating indigenous ecological knowledge into environmental governance also improves program relevance and effectiveness.

5.4 | Partnerships Between Government, Private Sector, and Non-Governmental Organizations

Cross-sectoral collaboration is essential to achieving sustainability on a large scale. Public-Private Partnerships (PPPs) can mobilize the financial, technical, and managerial capacity required for large-scale environmental projects such as afforestation, waste recycling, and renewable energy infrastructure [25]. Non-governmental organizations (NGOs), including the Nigerian Conservation Foundation (NCF) and the Heinrich Böll Foundation, have made significant contributions to community-based conservation and advocacy efforts. Scaling and institutionalizing such partnerships can amplify impact. In addition, Nigeria should actively utilize global climate finance instruments, such as the Green Climate Fund (GCF), and leverage its participation in international environmental agreements, like the Paris Agreement, to gain technical support and mobilize climate investments.

5.5 | Monitoring, Evaluation, and Adaptive Management

A sustainable development strategy is only as strong as its Monitoring and Evaluation (M&E) framework. Nigeria must institutionalize continuous data collection, performance evaluation, and adaptive management to track the effectiveness of environmental interventions. Key performance indicators should include forest coverage, biodiversity indices, air and water quality metrics, waste generation and recycling rates, and greenhouse gas emissions [26]. Establishing a centralized Environmental Information System (EIS) will enhance data integration, transparency, and evidence-based policymaking across government, academia, and civil society. Adaptive management practices ensure that sustainability programs remain flexible, scalable, and responsive to emerging environmental threats and opportunities.

6 | Innovation Model for Sustainable Development

To effectively address the complex challenges outlined above, this paper proposes an Innovation Model for Sustainable Development tailored to Nigeria's unique environmental, economic, and social context. This model serves as a strategic pathway designed to enhance national resilience against environmental degradation, drive inclusive economic growth, and promote social equity through sustainable practices. This approach aligns with global best practices and is adaptable to local realities, ensuring that both urban and rural communities benefit equitably from the sustainability initiative. Its premise is based on interdisciplinary

collaboration, evidence-based planning, and scalable solutions that support Nigeria's pursuit of environmental, economic, and social development goals.

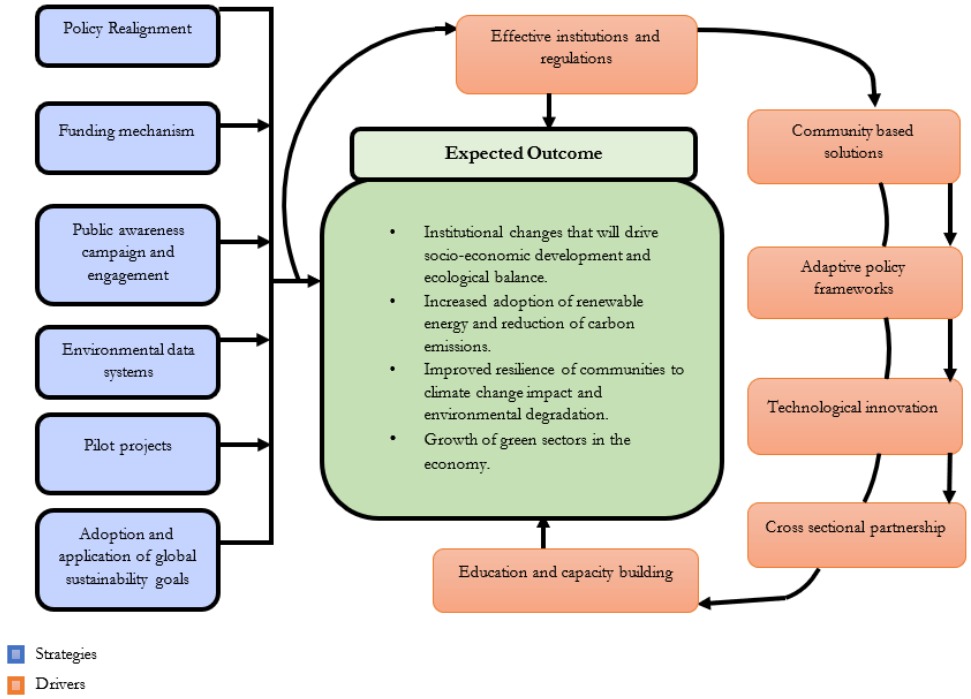
Policy Realignment
Funding mechanism
Public awareness campaign and engagement
Environmental data systems
Pilot projects
Adoption and application of global sustainability goals
Effective institutions and regulations
Expected Outcome
Institutional changes that will drive socio-economic development and ecological balance.
Increased adoption of renewable energy and reduction of carbon emissions.
Improved resilience of communities to climate change impact and environmental degradation.
Growth of green sectors in the economy.
Education and capacity building
Community based solutions
Adaptive policy frameworks
Technological innovation
Cross sectional partnership
Strategies
Drivers

Fig. 1. Innovation model for sustainable development in Nigeria.

6.1 | Core Structure and Logic of the Model

The proposed model aims to transition Nigeria toward an inclusive, economically prosperous, and environmentally secure future. It is built around two interrelated clusters.

Drivers / key components

These foundational pillars represent long-term enablers essential for driving sustainable development:

I. Effective Institutions and Regulations – Ensure robust enforcement of environmental laws, coordinated governance, monitoring, and evaluation across all relevant sectors.

II. Technological Innovation–Promotes the development and deployment of environmentally friendly technologies tailored to Nigeria's needs (e.g., solar energy, climate-smart agriculture, waste-to-energy systems).

III. Community-Based Solutions–Empower local communities by integrating indigenous knowledge and promoting local ownership of sustainability initiatives.

IV. Adaptive Policy Frameworks–Facilitate the formulation of flexible, data-driven policies that respond to changing environmental and socio-economic conditions.

V. Education and Capacity Building – Strengthen environmental literacy, build skills for green jobs, and promote leadership in sustainability through formal and informal education initiatives.

VI. Cross-Sectoral Partnerships–Encourage collaboration between government, private sector, civil society, and academia to scale sustainable practices and mobilize resources.

Implementation strategies

These practical mechanisms operationalize the key components and translate sustainability goals into measurable actions. They are the actionable pathways:

I. Policy realignment–integrates sustainability priorities into national development plans and sectoral policies to ensure coherence and alignment.

II. Funding mechanisms – Establish green financing structures, including grants, subsidies, and incentives, to support innovation and sustainability projects.

III. Public awareness campaign and engagement – Foster environmental consciousness and active participation through targeted campaigns, advocacy, and inclusive dialogue.

IV. Environmental data systems–provide real-time, evidence-based data to inform environmental planning, monitoring, and policy evaluation.

V. Pilot projects–implement and scale model initiatives (e.g., renewable energy villages, urban greening, smart agriculture) to demonstrate feasibility and impact.

VI. Adoption of global sustainability goals aligns Nigeria's development and national strategies with international frameworks, such as the SDGs, the Paris Agreement, and the Africa Agenda 2063.

Summarily, the model presents a holistic approach that integrates environmental, economic, and social dimensions to ensure inclusive, balanced, and sustainable development. It prioritizes eco-friendly technological innovation tailored to Nigeria's unique environmental challenges and local conditions. By emphasizing community-based solutions and integrating indigenous knowledge, the model reflects the realities and strengths of local communities. Furthermore, it reinforces the importance of effective institutions and regulatory frameworks, which are essential for strong governance and long-term policy enforcement, as well as monitoring and evaluation (M&E). The model also emphasizes cross-sectoral partnerships and engagement, which foster collaboration among key stakeholders, improving resource mobilization and shared responsibility. Again, it promotes education, capacity building, and public engagement to build a culture of sustainability and empower citizens for green economic opportunities. Lastly, by aligning with global sustainability targets, the model positions Nigeria to meet its national and international commitments while promoting inclusive and environmentally responsible growth.

7 | Conclusion

Environmental sustainability is not just a component of development—it is a critical enabler and a foundational pillar in the pursuit of sustainable development. It encompasses a holistic approach that balances ecological health, economic growth, and social well-being. In the Nigerian context, where natural resources underpin the country's economic and social systems, integrating environmental sustainability is crucial for long-term prosperity and climate resilience. Addressing challenges such as deforestation, pollution, climate change, and waste management through innovative, policy-aligned, and community-driven approaches ensures that development efforts are both inclusive and future-proof. Embracing environmental sustainability as a core development strategy will enable Nigeria to safeguard its ecosystems, foster inclusive economic growth, fulfill its global sustainability commitments, and build resilience for current and future generations.

Conflict of Interest

The authors declare that they have no conflict of interest.

Data Availability

All data are included in the text.

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